ADVANCE CHEMISTRY-II (PHYSICAL CHEMISTRY)
CREDIT HOURS: 3
COURSE OBJECTIVES

The objective of the course is for students:

1. Understand and apply the laws of thermodynamics and kinetics.

2. Understand the role that thermodynamics and kinetics play in chemical equilibrium.

3. Understand how mathematics, models and approximations are used to explain chemical phenomena and fundamental properties of matter.

4. Use concepts of thermodynamics/kinetics/equilibrium to make predictions and give explanations about chemical systems and fundamental properties of matter.

5. Develop skills in making decisions in the lab, in data acquisition, and critical evaluation of data.

6. Appreciate the role physical chemistry plays in chemical (physical, biological, etc. systems.

COURSE CONTENT:

1. **Electrochemistry:**
   Idea of conductance of electrolytes, Deby-Huckle equation and limiting law, ionic strength, weak electrolyte and Deby-Huckle theory, Activity and activity coefficients of electrolytic solution, determination of activities, concentration cells, Types of concentration cells, derivation of E.M.F of concentration cells with and without transference, Fuel cells and hydrocarbon cells.

2. **Quantum Chemistry:**
   Postulates of quantum theory, Eigen functions, operators, Schrödinger's wave equation, particle in one dimensional box, Normalized wave function and orthogonality, Quantum mechanical tunneling, motion of particle in three dimensional box and idea of degeneracy, separation of variables and derivation of quantum numbers, Mathematical treatment of rigid rotator and calculation of bond length of simple molecules, harmonic oscillator and calculation of bond length of simple molecules, harmonic oscillator and calculation of vibrational frequencies, formation of covalent bond, Mathematical treatment of He^+ and H_2 molecules, discussion of overlapping integrals, molecular orbital theory and formation of H_2 and O_2 molecules.

3. **Chemical kinetics:**
   Concept of rate law and order of reaction, Kinetics of 3rd order reaction with different concentrations and molecular identity, kinetics of opposing, parallel and consecutive reactions, basic experimental methods, Kinetics of thermally excited chain reactions like reaction of H_2 and Br_2, kinetics of thermal decomposition of ozone, N_2O_5 and CH_3CHO.

4. **Kinetics of bimolecular reactions:**
Mathematical treatment of collision and transition state theory of bimolecular reactions, effect of temperature of reaction rates, the interpretation of bimolecular reactions in solution, ionic reaction in solution, unimolecular gas phase reactions, fast reactions and their methods of study.

5. **Classical Thermodynamics:**
Maxwell's relations and thermodynamics formula, second law of thermodynamics, Clausius inequality, the entropy of non ideality of a gas, Nerst heat theorem, its applications to solid and gases, Nerst approximation formula, third law of thermodynamics and determination of entropy by third law, Experimental verification of third law. Adiabatic demagnetization.

6. **Statistical Thermodynamics:**
Sterling's approximation, statistical treatment of entropy, partition function and its physical significance, absolute entropy and partition functions, interpretation of thermodynamic functions in terms of translational, rotational vibrational and electronic partition functions, Free energy and equilibrium constant from partition function.

7. **Kinetic theory of Gases:**
Introduction, Maxwell distribution of molecular velocities and energies, Derivation of average velocity and most probable velocity, Barometric formula, effect of altitude, molar mass and temperature on vertical distribution of particles.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

RECOMMENDED BOOKS:

1. Physical Chemistry, Samuel Glasstone, 1995. Macmillan and Co. Ltd. St. marlins Street, London.
2. Principles of Physical chemistry, Maron and Prutton, 1965 the Macmillan Company, Collier Macmillan Ltd. London.
3. Physical Chemistry, Barrow, 1973, McGraw Hill, Tokyo.
4. Physical Chemistry, Moore, 1972, Rentice Hall, Englewood cliffs, Jersey.
5. Physical Chemistry, Alberty and Daniels, 1962, McGraw Hill Book Company Ltd London.
6. Physical Chemistry, Castallan, 1972, Addson Westey Publishing Company, Menla Park, California, London.
7. Physical Chemistry by Kundu, N and Jain, S.K.,S. Chand and Company Ltd. 1984.
8. Fundamentals of Chemical kinetics by Logan, S.R., Longman Group Ltd. 1996.
9. Elementry reaction kinetics by Latham. J.L. and burgess, A.E., 3rd Ed., Butterworths, London, 1997.
10. Physical Chemistry by Atkins, P.W., 5th Ed., W.H. Freeman and Company, New Yark, 1994.
11. Physical Chemistry by Alberty, R.A. and Silbey, R.J., John Wiley, New York, 1995.
12. Physical Chemistry by Engel, T. and Ried, P., 1st Ed,. Pearson education, Inc. 2006.
13. Electrochemical Methods and applications by bard, A. and Faulkner, L.R., John

Wiley, New York, 1980. Elements of classical and statistical thermodynamics by Nash, L.K. Addison Wesley Co. Ltd., 1979.
14. Hand book of surface and Colloid Chemistry by Birdi, K.S., CRC Press, 1997.
15. Heterogeneous Catalysis: Principles and applications by Bond, G.C., 2nd Ed., Oxford Clarendon press, 1987.
16. Surfactants and interfacial Phenomena by Rosen, Milton J., John Wiley, New York 1978.

ADVANCE CHEMISTRY LAB-II (PHYSICAL CHEMISTRY) CREDIT HOURS: 1

Physical Chemistry (Practical)

SYLLABUS OUTLINE:

1. **Basic Concepts:**
   Preparation of standard molar and Normal solutions and percentage compositions of different compounds.

2. **Chemical Kinetics:**
   To investigate the kinetics of hydrolysis of ethyl in the presence of an acid.
   To determine the relative strength of acids (HCl and H_2SO_4) studying the hydrolysis of an ester.

3. **Electric conductance of electrolytes:**
   To determine the cell constant of given cell.
   To determine the equivalence conductance of solution of weak electrolyte.
   At a no. of dilution at room temperature and from this result to verify Oswald's law.
   To determine the solubility of sparingly soluble salt.

To determine the solubility of weak base of NH_4OH by titrating it against Standard solution of HCl by using conductivity method.
To determine the strength of given base by titrating it against standard Acetic acid solution and HCl solution using conductivity meter.
To determine the strength of HCl and CH_3COOH in the given mixture of both by titrating it against NaOH conductometrically.
To determine the equivalent conductance of a weak electrolyte at infinite dilution using Kohlraush law.

4. **Phase Equilibria:**
   To determine the partition coefficient of benzoic acid and iodine between CCl_4 and H_2O.

5. **Refractrometery:**
   To determine the unknown concentration of sucrose solution and ethanol solution.

6. **Molar mass determination (Colligative properties):**
   To determine the molecular weight of a substance by cryoscopic method and Ebullioscopic method.

7. **Spectrophotometery:**
   To determine the wavelength of maximum absorption of compounds using spectrophotometer.
   To determine the unknown concentration of a compound using spectrophotometer.

8. **Phase Equilibrium:**
   To determine the phase diagram of Naphthalene and diphenyl system.
   To determine the phase diagram of urea and phenol.
   To determine the phase diagram of Benzoic acid and Naphthalene.

9. **Optical activity measurement:**
   To determine the unknown percentage composition of the following by using polarimeter (Sucrose, glucose).
   To determine the specific and molar rotation of optically active compound (sucrose, glucose).

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

RECOMMENDED BOOKS:

1. Advanced Experimental Physical Chemistry by Ayodhya Sing.
2. Experimental Physical Chemistry by Daniel
3. Experimental Physical Chemistry by G.Peter Mattews.
4. Experiments in Physical Chemistry by Shoemaker.